

Constant-Factor Approximation Algorithms for a Series of Combinatorial Routing Problems Based on the Reduction to the Asymmetric Traveling Salesman Problem

M. Yu. Khachai^{1,*}, E. D. Neznakhina^{1,2,**}, and K. V. Ryzhenko^{1,***}

Received May 12, 2022; revised June 14, 2022; accepted June 20, 2022

Abstract—For the first time, algorithms with constant performance guarantees are substantiated for a series of asymmetric routing problems of combinatorial optimization: the Steiner cycle problem (SCP), the generalized traveling salesman problem (GTSP), the capacitated vehicle routing problem with unsplittable customer demands (CVRP-UCD), and the prize collecting traveling salesman problem (PCTSP). The presented results are united by the property that they all rely on polynomial cost-preserving reduction to appropriate instances of the asymmetric traveling salesman problem (ATSP) and on the $(22 + \varepsilon)$ -approximation algorithm for this classical problem proposed by O. Svensson and V. Traub in 2019.

Keywords: asymmetric traveling salesman problem, constant-factor approximation algorithm, polynomial-time reduction, Steiner cycle problem, generalized traveling salesman problem, prize collecting traveling salesman problem, vehicle routing problem.

DOI: 10.1134/S0081543822060128

¹Krasovskii Institute of Mathematics and Mechanics, Ural Branch of the Russian Academy of Sciences, Yekaterinburg, 620108 Russia

²Ural Federal University, Yekaterinburg, 620000 Russia

e-mail: *mkhachay@imm.uran.ru, **eneznakhina@yandex.ru, ***kseniariizhenko@gmail.com